þÿ Finnish young adults perceptions of the health, sustainability of wooden interior materials

Häyrinen, Liina

2020-10-02

þÿ Häyrinen , L , Toppinen , A & Toivonen , R 2020 , ' Finnish young adul
health, well-being and sustainability of wooden interior materials ' , Scandinavian Journal of
Forest Research , vol. 35 , no. 7 , pp. 394-402 . https://doi.org/10.1080/02827581.2020.1813798

http://hdl.handle.net/10138/320285
https://doi.org/10.1080/02827581.2020.1813798

Scandinavian Journal of Forest Research

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/sfor20

Finnish young adults' perceptions of the health, well-being and sustainability of wooden interior materials

Liina Häyrinen , Anne Toppinen & Ritva Toivonen

To cite this article: Liina Häyrinen , Anne Toppinen & Ritva Toivonen (2020) Finnish young adults' perceptions of the health, well-being and sustainability of wooden interior materials, Scandinavian Journal of Forest Research, 35:7, 394-402, DOI: 10.1080/02827581.2020.1813798

To link to this article: https://doi.org/10.1080/02827581.2020.1813798

Published online: 17 Sep 2020.

SCANDINAVIAN JOURNAL OF FOREST RESEARCH
2020, VOL. 35, NO. 7, 394–402
https://doi.org/10.1080/02827581.2020.1813798

Taylor & Francis
Taylor & Francis Group

Finnish young adults' perceptions of the health, well-being and sustainability of wooden interior materials

Liina Häyrinen[a], Anne Toppinen [b,c] and Ritva Toivonen[b,c]

[a]Natural Resources Institute, Helsinki, Finland; [b]Faculty of Agriculture and Forestry, Department of Forest Sciences, University of Helsinki, Helsinki, Finland; [c]Helsinki Institute of Sustainability Science, Helsinki, Finland

ABSTRACT

Wood as a renewable construction material presents positive human health, well-being and sustainability-related features. Several studies have indicated its lower carbon footprint compared to the main alternative construction materials and its physiological and psychological characteristics have positive impacts on human health. The objective of this study is to investigate how young adults perceive the health, well-being and sustainability impacts of wooden interior materials. The findings from the four focus groups indicate that generally the image of wooden materials is positive although some concerns were identified. Further, wood as an interior material is perceived to have mainly positive psychological impacts on human health and well-being. From a sustainability perspective, participants recognized both negative and positive impacts of wooden materials mainly relating to environmental sustainability. Findings also revealed that although participants appreciate health and sustainability in the contexts of housing and particularly interior materials, still the materials' appearance and the financial situation of young participants' households dictate their criteria for choosing housing. The study results suggest that positive health impacts of wood, as well as its broader sustainability impacts, should be better acknowledged and promoted more broadly in society. This could result in greater appreciation towards wood and wooden materials among consumers.

ARTICLE HISTORY
Received 13 May 2020
Accepted 4 August 2020

KEYWORDS
Wood; consumers; focus groups; indoor materials; construction materials; housing materials; case study

Introduction

People of today's industrialized societies spend most of their time indoors: at home or at work, in schools or on transport, compared with citizens of earlier decades (e.g. Farrow et al. 1997; Hussein et al. 2012; Matz et al. 2014). As physical environments have been acknowledged to have an impact on well-being (Ulrich 1991; Brooks et al. 2017), indoor environments also have a significant impact on people's lives. For example, in the case of Finland, healthy construction has been a topical theme in the Finnish national debate due to increasing indoor air quality issues that have been publicized in the media and the severe negative health and economic impacts of low-quality indoor air.

At the same time, sustainability is likely to play an increasingly important role in future housing markets (Toppinen et al. 2018) and the share of consumers interested in renewable materials such as wooden interior materials is expected to increase due to rising concerns, awareness and discussion over global environmental challenges. In Finland, the building and construction sector is responsible for one-third of the country's greenhouse gas emissions and 40% of the total energy consumption in the national economy (Kuittinen and le Roux 2017). Given the major environmental impacts of the built environment due to design, construction, operation and maintenance (Conroy et al. 2019), wood has many positive features. Not only is wood a renewable material, it has also been shown in studies to have a lower carbon footprint compared to alternative building materials (Sathre and O'Connor 2010; Bergman et al. 2014).

So far, many previous studies have shown that natural environments have many beneficial effects on human health (e.g. Tyrväinen et al. 2014). Furthermore, wood as a building material has been found to positively affect human well-being and health, mainly due to physiological and psychological characteristics (Muilu-Mäkelä et al. 2014; Burnard and Kutnar 2015). In addition, wood material has some hygienic properties as indicated in the study of Vainio-Kaila (2017), which examined the anti-bacterial properties of wood and found that wood has various anti-bacterial qualities and several bacteria were sensitive to them. According to Kotradyová and Kaliňáková (2014), the ability of bacteria to survive on the wooden surfaces decreases over time. Concerning indoor air quality, a South Korean study by Cho et al. (2019) indicated that interior remodelling using wood improved the indoor air quality in welfare facilities. Furthermore, in a focus group study of Strobel et al. (2017), interior wood use was seen to improve indoor air quality. Künzel et al. (2004) have also shown the ability of wooden materials to balance indoor air humidity. Due to its many features such as good acoustic properties (Bucur et al. 2002), wood can be used in a variety of applications (Asdrubali et al. 2017). Previous research has also indicated that wooden materials can have

CONTACT Liina Häyrinen liina.hayrinen@luke.fi Natural Resources Institute Finland, Latokartanonkaari 9, 00790, Helsinki, Finland

psychologically beneficial impacts and are associated with lower stress levels (see reviews of Nyrud and Bringslimark 2010; Burnard and Kutnar 2015); they can also affect blood pressure (Sakuragawa et al. 2005; Sakuragawa et al. 2008).

In studies that have focused on consumers' perceptions of wooden materials, findings have shown that the reasons that consumers give for preferring wood are varied (e.g. Rice et al. 2006; Lähtinen et al. 2019). According to Rice et al. (2006) quality, durability, price and aesthetics have traditionally been the attributes that have affected the selection of wood materials among consumers when making a purchase decision. Indications exist that consumers perceive wood as a cosy, warm and aesthetic material (Tuuva-Hongisto 2010; Toivonen 2011) and wood is also associated with eco-friendliness and well-being (Gold and Rubik 2009; Palonen 2017). On the other hand, wood material is also linked to some concerns regarding durability, stability and fire safety (Gold and Rubik 2009).

Toivonen (2011) has argued that customers have recognized environmental sustainability as an element of total wood product quality. However, Gold and Rubik (2009) have stated that although considered being significant, these so-called soft criteria are not sufficient to trigger a choice in favour of timber by itself when selecting a certain building construction mode. Furthermore, Conroy et al. (2019) have studied architects' perceptions on the sustainability of wood products and found that although health and sustainability impacts of building materials are overall important, aesthetics, building codes and cost are even more important. According to Høibø et al. (2015), increasing consumers' knowledge of wood could increase preference for it as a material choice.

Given that the health and well-being impacts of wooden interior materials and benefits of wooden materials from sustainability perspectives are widely acknowledged, little is still known about how consumers perceive their health and sustainability impact. Particularly young consumers are an interesting group for research as their current perceptions can also reflect their future consumer choices. For example, in a Norwegian study, Høibø et al. (2015) indicated that younger people with environmental values could be potential targets for wood-based urban housing. To fill the gap, this research is conducted among Finnish young adults, as future decision makers and home buyers, with objectives to:

(I) increase an understanding of how the health and well-being impacts of wooden interior materials are perceived and what kind of related concerns exist;
(II) investigate how the quality of good indoor air is understood and how the use of wood as a material is perceived to affect indoor air;
(III) investigate how sustainability is understood in the context of housing and living and
(IV) increase the understanding of how sustainability of wooden construction materials is perceived, and what kind of related concerns exist in the use of wood as construction material.

Table 1. Summary of focus groups.

Focus group number	Location	Number of participants	Duration (minutes)	Age of participants
1	Helsinki, Finland	5 (3 females, 2 males)	83	22–28
2	Helsinki, Finland	5 (4 females, 1 male)	75	22–29
3	Helsinki, Finland	4 (all females)	74	23–27
4	Helsinki, Finland	5 (all females)	87	22–29

While there has been considerable research on the choices consumers make about interior materials, and even their attitudes towards wooden materials, we have chosen to focus on the preferences of young people as they will eventually become consumers of more permanent housing. So far, research on younger consumers has not been as extensive as other earlier research.

Materials and methodology

Data were gathered by organizing four focus group thematic discussion sessions in Helsinki in October 2019. Most of the participants were recruited among the residents of student apartments who responded to an electronic quantitative survey in October 2018 (for findings of the survey, see Kylkilahti et al. 2020). Focus group participants were recruited among student population in the area, and their age was between 18 and 30 years. Altogether 19 students participated in the discussion. We estimated that the number of focus groups and participants would be sufficient to adequately present different perspectives on the issue under study. Each focus group discussion lasted between 74 and 87 min and was led by the first author as a facilitator.

From all 19 participants 16 were females and 3 males, which can be justified for females being typically more interested in interior design and material choices. Participants' year of birth ranged from 1990 to 1997. All participants were currently living in the Helsinki metropolitan area, but 12 were born elsewhere in Finland or abroad and one participant did not report the place of birth. Eighteen participants lived in a rented apartment and one in an owner-occupied apartment. Fifteen of them were full-time students, two were full-time employees, one was on parental leave and one reported being both a student and an employee. Three of them studied in the university of applied sciences 14 were studying at university level and the other two participants had graduated from university of applied sciences or from another university.

Before beginning a session, participants were asked to complete a background form (gender, year and municipality of birth, education, type of accommodation and professional status). Participants were also assured that all the conversations are handled and reported confidentially. Participants were given the opportunity and encouraged to comment on each other's perceptions and opinions. Discussions were recorded using audio recorder equipment. Transcripts were created by an external service provider and the first author did the translations of the transcripts quoted.

During the focus group discussions, photographs of wooden interior materials and their applications were shown to focus group participants to create an inspiring atmosphere. Participants discussed 20 pre-defined questions

and related follow-up questions (see Appendix for presented questions). Therefore, in addition to findings presented in the present article, questions consist of other related areas as well.

Results from the focus group discussions based on data analysis are not to be generalized to any larger population. However, the resulting data and its qualitative analysis help to further examine the themes and phenomena of interest in this study compared to many quantitative research methods mainly based on statistical data (e.g. Kitzinger and Barbour 1999) (Table 1).

The focus group data were content analysed using Atlas.ti software. Transcripts were coded by identifying key issues from each of the topics. Data were analysed in a manner that it was aimed at collecting more general themes discussed in focus groups. Due to relatively small number of participants, some of the reported findings may reflect the views of only some of the participants. However, this process included diverse perspectives in the results.

Results

Description of participants

Before the introduction of actual themes related to the four research questions, the participants discussed their current form of living and living neighbourhoods during their childhood and adolescence. Most of the participants lived currently in an apartment building either alone or with a partner. While the current housing situation was similar for most of the participants, there were differences in the living history of the participants. Participants' living history included living in blocks of flats, wood or brick detached houses and brick terraced houses. Some of the respondents had lived in the same house during their whole childhood and adolescence, while a few had moved several times.

In the beginning, participants discussed in general terms what positive and negative images or feelings wood evokes as an interior material. Many comments were related to the material's appearance and whether it was luxurious, elegant and pleasing as a detail. However, most of the participants felt that if wood is used too extensively, it can create a stuffy, dark and old-fashioned atmosphere.

Table 2. Summary of main findings on young Finnish adults' perceptions on positive and negative human health and well-being aspects of wooden interior materials. Bolded aspects appeared most frequently in the focus group discussions.

Health and well-being impacts of wooden interior materials	Health and well-being related concerns of wooden interior materials
• **Calm** • **Less Stressful** • **Cosy** • **Soft material (safer for physical health)** • **Warm (e.g. floor)** • **"Nature enters room"** • Anti-bacterial • Safe, peaceful • Breathable • Acoustic properties	• **Surface treatment of wooden material** • **Mould** • Fire safety • Hygiene/possibility to clean • Dust or allergens • Absorption of odours and liquids • Pests and wooden materials (e.g. bedbugs from abroad)

Wood was also characterized as having more functional properties such as being versatile and repairable material but easy maintenance and cleaning was also questioned. The more psychological aspects mentioned were naturalness and cosiness. Participants also emphasized that positive and negative aspects related to the application of the wood in terms of what kind of wood is used and how and where it is used.

Health and well-being impacts of wooden interior materials

The first focus group theme asked participants to elucidate what kind of physical or psychological health impacts of wooden interior materials they were aware of or recognized (Table 2). The most discussed health impact was the calming effect of wood that was brought up in every focus group. In some cases, the stress relieving properties of wood were also discussed. In addition, being familiar with wood material was considered to bring peace of mind. Very closely related to the psychological impacts, including a feeling of well-being was the cosiness of wooden interior surfaces, which was mentioned quite frequently. Bringing "nature" into the apartments and thereby feeling closeness to nature inside the built environments was seen as very important among the participants and was discussed in two focus groups. These are exemplified by the following quotes:

> Somehow I like to think that when you get that little bit of nature and not just live in some concrete, then it somehow calms you down and relieves stress at the same time; in a way it makes your life easier. (Female, Group 4)

> Maybe it's more of a spiritual aspect that when the table is wood or … maybe this is the whole peace of mind after all. You know what it is and wood brings a sense of security as well. (Male, Group 1)

Although psychological impacts were emphasized among the focus group participants, these and physical impacts can also overlap and be difficult to separate from each other in many cases. The breathability of wooden interior materials was also identified as a health impact and some participants felt that the air to be breathed was different in homes made of wooden materials. The warmth of wooden interior materials was also considered as a health impact and was discussed both from psychological and physical viewpoints. The softness of wood was also stated to be a positive health issue, which is why wood was also considered safer for physical health compared to concrete, for example, when a person falls down indoors on a wood floor. In addition, the acoustic properties of wooden surfaces especially in large public buildings were considered positively.

> … How to describe, multi-sensory that may not come from any other material, just that, and in a way, that material feels good to touch, looks good and can still smell good. (Female, Group 2)

> It reminds me of my grandmother's cottage or grandmother's childhood home, when it's such an old wooden house and it's always so wonderfully cool and, well, it's good to sleep there.

> And the air changes somehow. … It feels easier to breathe there. (Female, Group 4)

While the anti-bacterial properties of wood were acknowledged in one of the focus group groups, perceptions on hygienic aspects of wood were somehow contradictory as many participants were more concerned and suspicious on hygiene and maintenance of wooden surfaces. One of the focus group participants explained it as follows:

> I do not remember where I read or from whom I heard it … but the tree is apparently very anti-bacterial, … I'm also a nurse that I do not see why it would not be possible in hospitals. And just like that, we start talking about having good bacteria in the tree instead of the bad ones. Maybe the tree could come into the picture … I'm not an expert of course … I'd love to see more wood just in public places … . (Female, Group 4)

When asked about the concerns about the use of wood as an interior material for human health, discussion differed among the groups. While in two groups mould was brought up as a health concern to some extent, another group was hardly able to name any concerns at all. In two groups more concerns were discussed such as how the surface treatment of wood material affects human health. Other concerns identified that were discussed only to a small extent were fire safety and hygiene of wooden materials. In addition, a few participants questioned whether wooden surfaces absorb odours and liquids easily, collect dust and allergens or if pests live better in wooden materials. Amongst those participants, the following discourses emerged:

> I also thought about how that tree was treated […] So if it is treated with some sort of a poison to prevent mould, is it better than some plastic? Or maybe that wood would be as natural as possible or treated with the least poison (Female, Group 4)

> I don't know; you can't make a hospital out of wood even if you feel like it. The environment requires so much cleaning and hard chemicals to prevent people from catching any bacteria or germs. But it would be interesting if you could do something in the hospital out of wood … Would it make any difference? (Female, Group 2)

However, participants were not as easily able to name many concerns and participants often emphasized that they do not either have concerns and their attitudes towards interior wood use were mainly neutral or positive.

Indoor air quality and the related influence of wood

The second focus group theme requested participants to determine what "good indoor air quality" means to them in practical terms (Table 3). In most focus groups, good indoor ventilation was seen as critical. Participants generally desired good indoor air to be fresh, pure and temperature regulated. Furthermore, other adjectives to describe good indoor air quality were mould-free and chemical-free. In one group, participants discussed the uncertainty of factors that cause poor indoor air. For instance, participants expressed:

> I also thought that the ventilation would work in such a way that if there is something there … from cooking or other source, that then it will not stay there for a long time, because if it stays, it (air) won't move anywhere. (Female, Group 1)

> It is a little difficult, that what causes the poor indoor air, that it is mould … . whether it is the emission of VOC (volatile organic compounds) from the paint, what evaporates from the paint … nowadays almost all interior paints are plastic and the floor coverings (Male, Group 1)

> Well, I feel that … it could be said that there is no particular smell when you enter; the air is a bit fresh. (Female, Group 3)

When asked whether wood affects indoor air positively or negatively, the outcome was predominantly positive. Wood was described as a breathable material compared to other materials such as concrete and plastic. Some characteristics of wooden materials were also questioned. For example, some participants were unsure whether wooden materials are more sensitive to moisture. One participant asked whether uneven wooden surfaces collect dust and therefore affect the indoor air negatively. Again, the choice of application was mentioned as one factor that can have an impact on whether wooden materials have positive or negative impacts on indoor air. However, as one participant exemplified, building solutions may not be able to influence indoor air, as external factors such as neighbours' smoking cannot be ruled out. These are elaborated by the following quotes:

> To me, wood is at least a pretty breathable material … air can change in some way there. It may not block it with moisture at all to somewhere between the structures. And maybe it depends a little on how the wood has been treated, but it won't release any terrible things … (Female, Group 1)

> Well, even though the wood is wonderful … I don't know if it is really true, but somehow it feels like the wood can also easily absorb everything that it can, like what it sucks, then get it off, even if it is not dangerous … Let's think about some food smells. Do they start to accumulate a little musty smell in that wood material? (Female, Group 3)

Sustainability of wooden construction materials – what does it consist of?

Prior to discussion of the sustainability impacts of wooden materials, participants were asked to describe what

Table 3. Summary of main findings of young Finnish adults' perceptions on aspects related to indoor air quality and wood material. Bolded aspects appeared most frequently in the focus group discussions.

Definition of good indoor air quality	Influence of the use of wood as an interior material on indoor air
• **Air changes (Good ventilation)** • **Breathability** • **Fresh** • **Pure** • **Pleasant air temperature** • **Neutral change when moving from outside to inside** • Mould-free • Chemical -free • Pleasant air humidity • Symptom free	*Potential positive impacts* • **More breathable material (compared to plastic and concrete)** • Humidity control • Wood remains hygienic (different opinions) • No emissions (VOC) if not surface treated *Potential negative impacts* • **Moisture sensitivity** • Absorption of odours and liquids • Dust collection on uneven surfaces

sustainability means to them in the wider context of housing and living (Table 4). In all groups the consensus was that sustainability in housing means that apartments and used materials are durable. In addition, in three groups it was perceived as the long lifetime of apartments. Related to this, participants also considered the timeless appearance of the apartments to be an important feature of sustainable housing. Furthermore, the fact that the building has been well built from the beginning was mentioned in this context. Participants also felt that to be sustainable, apartments should be easy to fix, modify or maintain. Other matters mentioned were easy disposal and reusability of used materials, energy consumption and durability against weather conditions. Therefore, participants perceived sustainability from both ecological and material durability perspectives.

> That it is not such a disposable building lifecycle; it should immediately be designed in such a way that it will last not 30 years, but for the next 100 years. It must be built so that it will remain usable until then. (Female, Group 1)

> That in a way it can be somehow refurbished … another coat of paint applied or something like that. (Female, Group 3)

> And maybe somehow, I combine eco-friendliness with health and durability; they somehow go hand in hand. (Female, Group 4)

Table 4. Summary of main findings of young Finnish adults' perceptions of wood material and its human health and well-being impacts and overall sustainability. Bolded aspects appeared most frequently in the focus group discussions.

Sustainability in context of housing	Sustainability of wooden materials	Sustainability concerns
• Durable • Long-lasting • Easy to fix, modify or maintain • Quality of construction • Timeless appearance • Energy consumption • Reusability of material • Easy disposal of material (non-poisonous) • Weather resistant	*Environmental (or ecological)* • **Carbon storage** • **Easier to dispose or recycle** • **Origin of wood: use of tropical wood (preferred domestic)** • **Increased use of wood** • **Excessive forest use/ too intensive logging** • **Better utilization of raw materials** • Impact of surface treatment on the environment *Social* • **Origin of wood → treatment of local residents and employees** *Durability* • **Quality of construction** • **Serviceability/ repairability** • Fire safety	*Environmental (or ecological)* • **Unknown wood origins** • **Sustainability of logging** • **Environmental impact of surface treatment** • Resource efficiency of production • Greenwashing *Durability* • **Requires maintenance and surface treatment** • Durability (depends on application) • Swelling of wood • Use of low-quality raw material • Traces of wear (selection of application) • Future price-quality ratio

Discussion of sustainability of wooden materials revealed three main dimensions of sustainability-related perceptions. First, based on the number of discussions, environment-related domain of sustainability has the highest priority. In some groups, it was speculated whether the use of wood would increase significantly as it also has impacts on the environment. In the same context, too intensive logging was discussed as a potential sustainability impact. Generally, participants thought that wooden materials are easier to dispose of or recycle compared to competing materials. However, the raw material should be utilized more efficiently according to some groups. A few times, the role of wood as long-term carbon storage was highlighted during the discussions. However, it seemed that those participants who discussed it, meant carbon storage but actually talked about carbon sinks. Participants also recognized the origin of wood to be very essential from an ecological viewpoint: the use of tropical wood was generally suspected and participants expressed that they preferred domestic wood as more sustainable.

> Wood is very recyclable, depending on whether or not it has been treated; it can probably be burned or it may even rot, even if it does not contain those substances or it can somehow be disposed of in contrast to plastic, which is such a problematic material. (Female, Group 2)

The second sustainability dimension recognized in the group discussions was material durability. One participant considered that easy maintenance of apartments and materials are essential aspects in order to be sustainable. Furthermore, according to the participants, wooden materials are durable as long as the quality of construction is of a high standard. One participant articulated this perspective:

> There are wooden houses that have lasted a hundred years easily. Then again, there are houses built using the most modern building techniques that have had to be demolished. On the other hand, I see that wood is definitely an exceptionally durable material if it is used in construction that is really well built. (Female, Group 4)

The third dimension of sustainability was perceived to be the social domain of impacts related to wood and wood material. These were perceived comprising origin of wood, particularly from the perspective of local residents and employees. Thus, as summarized by one of the participants:

> Well, it's probably just where the wood is brought from – these fine mahogany parquet floors and so on. It's really stunning but then that wood is brought from some rainforest and you do not know how the forest and the workers' conditions are respected there. I would consider a few times before I would go for it. (Male, Group 1)

When participants were asked to discuss concerns related to the use of wooden materials in construction, they expressed concern about both sustainability and durability. Participants were at some level concerned about the origin of the wood. Some participants especially questioned if it is possible to know whether the wood comes from sustainable resources. Sustainability of logging was also questioned by a few participants in the context of Finland. One participant was also curious to know whether the production of

wooden materials is resource-efficient. Some participants were uncertain what kind of impacts the surface treatment of wood has on the environment. On the other hand, they felt that it is contradictory, because wood has to be treated in order to sustain the consumption. In addition, greenwashing was also mentioned as exemplified by the following statement:

> Wood is often marketed as sustainable … I feel that it is often the case that … it is marketed as sustainable even though it is not sustainable. People can also easily be fooled into believing that I am doing something good right now, even though it is not, in any way, a reasonably sourced wood. (Female, Group 2)

> I also think a little bit about whether there is a better one … Or if you are thinking about logging … is there some more sensible logging method … I don't know what to trust anymore in these sustainable logging discussions [laughs]. (Female, Group 4)

Concerns related to more physical properties of wooden materials (durability impacts) were swelling of wood and the use of low-quality raw material. It was brought up in a few groups that the use of wooden materials requires maintenance and surface treatment. Therefore, the durability of wooden materials and traces of wear on wood all come down to the selection of application. One participant was also worried on price–quality ratio of wooden materials in the future. Sustainability impacts and concerns were at some level intertwined; thus, it was difficult to carefully divide impacts and concerns into separate categories (Table 4). For instance, one participant stated:

> It comes to my mind that wood is a living material … when it absorbs moisture, the wood will swell; how long will the surface look clean and even? Boards may begin to hump and detach from the rest of the ceiling. (Male, Group 2)

Discussion and conclusions

This study investigated young consumers' perceptions of health and well-being and sustainability impacts of wooden interior materials. Findings from the four focus group discussions revealed that people in their twenties mainly appreciate wood positively regarding the health and sustainability impacts, in the contexts of housing and particularly interior material. Although generally the choice of wooden materials was positive and safe, it was also questioned by some participants whether wood is better for health than other materials. However, it was also evident that now money plays an especially important role in students' housing choice criteria. Due to the life situation of the participants, as many of them stated, their housing choices have not yet been much considered. Further, the participants showed some consistency in their views that from a health point of view, wood could be favoured more but too much wood does not please the eye.

Naturalness, cosiness and relaxing features of wood were the most indicated health and well-being impacts in focus groups that have also been revealed in previous studies (Rice et al. 2006; Nyrud and Bringslimark 2010; Palonen 2017). Further, the findings of the study showed that surface treatment of wooden materials was seen as having an impact on both human health and the environment. Thus, it is evident that participants generally preferred materials that require minimal treatment, which is also in line with the study of Burnard et al. (2017) who found that people in Finland, Norway and Slovenia rated less processed materials such as wood, stone and brick to be more natural compared to more processed materials. Further, wood was generally seen to improve indoor quality, which is also in line with what was previously identified by Strobel et al. (2017). From the sustainability perspective of housing in general, an interesting observation from the discussions was also the importance of materials' timeless appearance, which leads to a longer life cycle of construction materials.

The perceptions of interior wood use among participants were often associated with the context and application of wood use. It is evident that wood has many more potential applications where it could be beneficial for human health. There is a plenty of potential to promote wooden materials especially from the psychological well-being perspective. Thus, there are many potential applications especially in public construction or care facilities where the positive attributes of wood could be more utilized. While people spend many hours in indoor offices, these could be applications to increase the use of wooden interior materials (see e.g. Burnard and Kutnar 2015). Furthermore, interior materials in homes for the elderly as well as schools and day care centres made from wood could be potential applications in terms of the material's relaxing and restful effects. From the viewpoint of companies manufacturing and marketing wooden interior materials, there is nonetheless a need for balancing between health and visual aspects of wooden materials (see also, Nyrud et al. 2014). On the other hand, participants of this study were uncertain and felt that they lacked knowledge on the health and well-being impacts of wooden materials.

Furthermore, from the sustainability viewpoint, consumer segments can differ in terms how they perceive the benefits of wooden materials (see e.g. Lähtinen et al. 2019) and this aspect should be considered when marketing these products. That said, there is a call for developing more clear communication and provisioning neutral information on wood-based materials from manufacturers' side (see also, Rice et al. 2006), which could also result in a greater appreciation of wooden interior materials and increase the value of wooden materials among consumers.

Interestingly, the focus group discussions of young Finnish adults revealed three dimensions of sustainability domains: environmental, social and material durability. Participants recognized both negative and positive impacts of the production of wooden materials mainly relating to environmental sustainability. Although the durability and environmental sustainability domains were perceived to intertwine relatively closely in focus group discussions, the environmental domain seems to link also to the social domain as some participants discussed the origin of wood and simultaneously the impact of logging on the local people and their environment. Further, these three identified domains of sustainability also include impacts that also are either directly or indirectly linked to human health and well-being (e.g. impact of

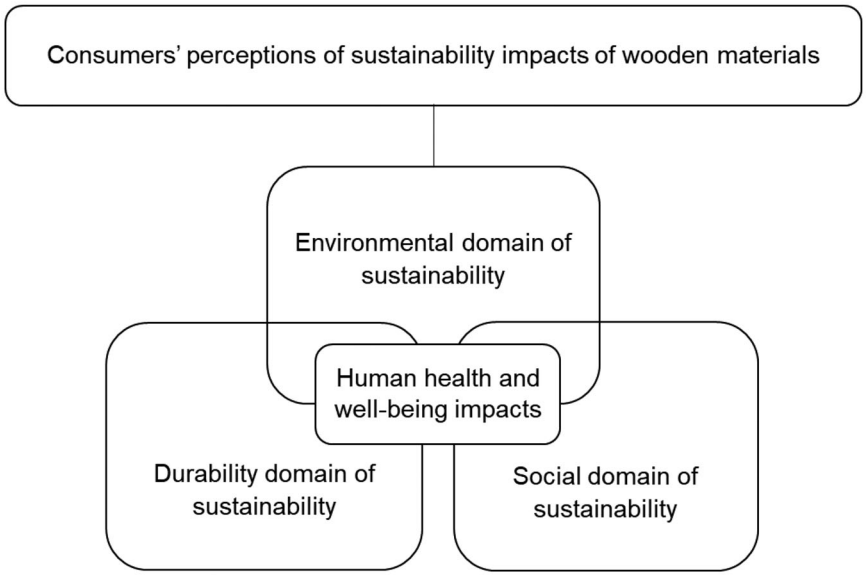

Figure 1. The identified relationships among the three identified domains of sustainability based on focus group discussions.

surface treatment on both the environment and health and fire safety or quality of construction from the durability and human health perspectives). Some focus group participants also mentioned the interlinkage of sustainability and human health and well-being although these impacts remained rather abstract. These interlinkages are demonstrated in Figure 1. Thus, it can be argued that a deeper understanding of the relationships of these concepts requires more research because consumers are lacking clear information (see also Lähtinen et al. 2019).

Further, the perception of wood use can also be driven by cultural expectations, as stated by Strobel et al. (2017) who also used group discussions as a method using data from five European countries. Therefore, it should be kept in mind that the findings of this study can only be applied in the Finnish context and are drawn from a limited small group of educated young people in an urban context. For example, in the Finnish language, the term sustainability is multifaceted and includes the notions of durability and longevity.

Due to the qualitative approach of this study, it can be assumed that not all perspectives were discussed; therefore, complete saturation of the gathered data has not been obtained. However, the data provides a tentative understanding on the investigated theme. Consequently, it could be interesting to study in more depth the perceptions on health and sustainability of wooden interior materials of people living in countries where the culture for wood is weaker. Evaluating the health impacts of wooden materials would be particularly interesting and require further studies under controlled experimental conditions. Thus, experiences of people spending time in wood-dominated interior buildings are needed in real-life contexts. Therefore, it could also be useful to study people's experiences and perceptions on a longitudinal basis. In addition, future studies could explore the impacts of peoples' background characteristics (e.g. education, gender, housing situation) on their perceptions of the health, well-being and sustainability of wooden materials.

Therefore, the results of this study indicate that consumers' perceptions of the health and well-being impacts of wood are to some extent related to all three dimensions of sustainability domains but their relationships are still quite out of touch with actual scientific data or research. Thus, it is important to produce scientific information on these relationships and develop ways in which consumers can be informed about these interlinkages. Consequently, due to increasing climate awareness, and even anxiety, along with rising awareness of problems with quality of building and the influence of indoor air quality on human health among consumers, there are pressures for construction companies to take better care of these aspects. The ongoing pandemic situation has accelerated these safety concerns arising from indoor air quality. Toward future, increasing attention in the field of construction is likely on the health and sustainability aspects related to housing, including the materials used.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

The authors gratefully acknowledge the financial support from Puumiesten Ammattikasvatussäätiö.

ORCID

Anne Toppinen http://orcid.org/0000-0003-0910-1505

References

Asdrubali F, Ferracuti B, Lombardi L, Guattari C, Evangelisti L, Grazieschi G. 2017. A review of structural, thermo-physical, acoustical, and environmental properties of wooden materials for building applications. Build Environ. 114:307–332. DOI:10.1016/j.buildenv.2016.12.033.

Bergman R, Puettmann M, Taylor A, Skog K. 2014. The carbon impacts of wood products. For Prod J. 64(7/8):220–231. DOI:10.13073/fpj-d-14-00047.
Brooks A, Ottley K, Arbuthnott K, Sevigny P. 2017. Nature-related mood effects: season and type of nature contact. J Environ Psychol. 54:91–102. DOI:10.1016/j.jenvp.2017.10.004.
Bucur V, Lanceleurb P, Rogec B. 2002. Acoustic properties of wood in tridimensional representation of slowness surfaces. Ultrasonics. 40(1–8):537–541. DOI:10.1016/S0041-624X(02)00182-8.
Burnard M, Kutnar A. 2015. Wood and human stress in the built indoor environment: a review. Wood Sci Technol. 49:969–986. DOI:10.1007/s00226-015-0747-3.
Burnard M, Nyrud A, Bysheim K, Kutnar A, Vahtikari K, Hughes M. 2017. Building material naturalness: perceptions from Finland, Norway and Slovenia. Indoor Built Environ. 26(1):92–107. DOI:10.1177/1420326X15605162.
Cho HM, Lee J, Wi S, Kim S. 2019. Field study on indoor air quality of wood remodeled welfare facilities for physical and psychological benefits. J Clean Prod. 233:197–208. DOI:10.1016/j.jclepro.2019.05.293.
Conroy K, Riggio M, Knowles C. 2019. Perceptions of the environmental and health impacts of wood product use in buildings: a survey among architects on the United States West Coast. BioProducts Business. 4(9):109–124. DOI:10.22382/bpb-2019-009.
Farrow A, Taylor H, Golding J. 1997. Time spent in the home by different family members. Environ Technol. 18(6):605–613. DOI:10.1080/09593331808616578.
Gold S, Rubik F. 2009. Consumer attitudes towards timber as a construction material and towards timber frame houses – selected findings of a representative survey among the German population. J Clean Prod. 17(2):303–309. DOI:10.1016/j.jclepro.2008.07.001.
Høibø O, Hansen E, Nybakk E. 2015. Building material preferences with a focus on wood in urban housing: durability and environmental impacts. Can J Forest Res. 45(11):1617–1627. DOI:10.1139/cjfr-2015-0123.
Hussein T, Paasonen P, Kulmala M. 2012. Activity pattern of a selected group of school occupants and their family members in Helsinki – Finland. Sci Total Environ. 425:289–292. DOI:10.1016/j.scitotenv.2012.03.002.
Kitzinger J, Barbour R. 1999. Introduction: the challenge and promise of focus groups. In: Barbour R, Kitzinger J, editors. Developing focus group research. London: SAGE. DOI:10.4135/9781849208857.n1
Kotradyová V, Kaliňáková B. 2014. Wood as material suitable for health care and therapeutic facilities. Adv Mat Res. 1041:362–366. DOI:10.4028/www.scientific.net/AMR.1041.362.
Kuittinen M, le Roux S. 2017. Procurement criteria for low-carbon building. Environment Guide 2017. Helsinki, 2018: Ministry of the Environment; [accessed 2020 Jan 15]. https://pdfs.semanticscholar.org/2941/c06492996eeb1fad0980d6f29cfaed0c39db.pdf.
Künzel H, Holm A, Sedlbauer K, Antretter F, Ellinger M. 2004. Moisture buffering effects of interior linings made from wood or wood-based products. IBF Report HTB-04/2004/e. Fraunhofer – Institut für Bauphysik, Stuttgart, Germany; [accessed 2020 Jan 15]. http://www.ibp.fraunhofer.de/content/dam/ibp/en/documents/oeVB_eng_3_tcm1021-30995.pdf.
Kylkilahti E, Berghäll S, Autio M, Nurminen J, Toivonen R, Lähtinen K, Vihemäki H, Franzini F, Toppinen A. 2020. Student perceptions on the use of wood in multi-story buildings. Submitted manuscript. AMBIO.
Lähtinen K, Harju C, Toppinen A. 2019. Consumers' perceptions on the properties of wood affecting their willingness to live in and prejudices against houses made of timber. Wood Mater Sci Eng. 14(5):325–331. DOI:10.1080/17480272.2019.1615548.
Matz C, Stieb D, Davis K, Egyed M, Rose A, Chou B, Brion O. 2014. Effects of age, season, gender and urban-rural status on time-activity: Canadian human activity pattern survey 2 (CHAPS 2). Int J Environ Res Pub Heal. 11(2):2108–2124. DOI:10.3390/ijerph110202108.
Muilu-Mäkelä R, Haavisto M, Uusitalo J. 2014. Puumateriaalien terveysvaikutukset sisäkäytössä. Working Papers of the Finnish Forest Research Institute 320 (in Finnish); [accessed 2019 Dec 1]. http://www.metla.fi/julkaisut/workingpapers/2014/mwp320.pdf.
Nyrud A, Bringslimark T. 2010. Is interior wood use psychologically beneficial? A review of psychological responses toward wood. Wood Fiber Sci. 42(2):202–218.
Nyrud A, Tina Bringslimark T, Bysheim K. 2014. Benefits from wood interior in a hospital room: a preference study. Archit Sci Rev. 57(2):125–131. DOI:10.1080/00038628.2013.816933.
Palonen K. 2017. Kuluttajien asumisvalinnat sekä näkemykset puusta rakennusmateriaalina – "se ei oo semmonen kivihirviö" [master's thesis]. University of Helsinki, Faculty of Agriculture and Forestry, Department of Economics and Management. (in Finnish); [accessed 2019 Dec 1]. http://urn.fi/URN:NBN:fi:hulib-201708225233.
Rice J, Kozak R, Meitner M, Cohen D. 2006. Appearance wood products and psychological well-being. Wood Fiber Sci. 38(4):644–659.
Sakuragawa S, Kaneko T, Miyazaki Y. 2008. Effects of contact with wood on blood pressure and subjective evaluation. J Wood Sci. 54:107–113. DOI:10.1007/s10086-007-0915-7.
Sakuragawa S, Miyazaki Y, Kaneko T, Makita T. 2005. Influence of wood wall panels on physiological and psychological responses. J Wood Sci. 51:136–140. DOI:10.1007/s10086-004-0643-1.
Sathre R, O'Connor J. 2010. Meta-analysis of greenhouse gas displacement factors of wood product substitution. Environ Sci Policy. 13(2):104–114. DOI:10.1016/j.envsci.2009.12.005.
Strobel K, Nyrud A, Bysheim K. 2017. Interior wood use: linking user perceptions to physical properties. Scand *J Forest Res*. 32(8):798–806. DOI:10.1080/02827581.2017.1287299.
Toivonen R. 2011. Dimensionality of quality from a customer perspective in the wood industry [dissertation]. Forestales 114. 71 p. DOI:10.14214/df.114.
Toppinen A, Röhr A, Pätäri S, Lähtinen K, Toivonen R. 2018. The future of wooden multistory construction in the forest bioeconomy – a Delphi study from Finland and Sweden. J Forest Econ. 31:3–10. DOI:10.1016/j.jfe.2017.05.001.
Tuuva-Hongisto S. 2010. Puu asumisessa –kuluttajanäkökulma puurakentamiseen. Metsäalan ennakointi yksikkö. University of Eastern Finland (in Finnish); [accessed 2019 Dec 1]. https://epublications.uef.fi/pub/urn_isbn_978-952-61-0158-3/urn_isbn_978-952-61-0158-3.pdf.
Tyrväinen L, Ojala A, Korpela K, Lanki T, Tsunetsugu Y, Kagawa T. 2014. The influence of urban green environments on stress relief measures: a field experiment. J Environ Psychol. 38:1–9. DOI:10.1016/j.jenvp.2013.12.005.
Ulrich R. 1991. Effects of interior design on wellness: theory and recent scientific research. J Health Care Inter Des. 3(1):97–109.
Vainio-Kaila T. 2017. Antibacterial properties of Scots pine and Norway spruce. Aalto University publication series DOCTORAL [dissertation] 179. 70 p; [accessed 2020 Nov 29]. http://urn.fi/URN:ISBN:978-952-60-7620-1.

Appendix

Frame for the focus group discussion. Hints (in parentheses) were given if it was difficult for participants to begin the discussion based on the actual question. Only bolded questions were reported in the context of the article as they were considered to be the most relevant questions to solve the research problem.

Warm-up and introductory questions

- Introduction and background of the facilitator
- The general aim of the focus group session:
- Examine young adults' perceptions of wooden interior materials, especially from the perspective of health, well-being and sustainability
- Examples of areas where wood can be used indoor include floors, walls, ceilings, doors, mouldings and door frames. The actual use of wood in structures as in wooden multi-storey buildings and wooden furniture are mainly outside the scope of the study but these aspects can be mentioned in the discussions because different applications of wood use cannot be fully distinguished

Practical issues: Discussions will be recorded and they will be handled and reported confidentially and the material will not be used for non-research purposes

Recording starts

1. Background

(a) What kind of apartment do you live in? (size of the apartment and household, type of housing). – Housing History: What kind of apartment did you live in as a child and in adolescence?
(b) How do you define sustainability and what does it mean to you in the wider context of housing and living?
(c) Have you discussed with your friends/family about the sustainability and health of housing and your apartment? If so, what kind of things have come up and why?
(d) What kind of wood materials do you have in your home or are there any? Have you ever bought anything made from wooden materials for your home?
(e) What do you think of the visible wood in the apartment?
- What kind of wooden materials there could be, but are not currently there?
- Where would you like wood to appear in your home? Why?
- What would be your health and sustainable dream house? (what kind of apartment, size m^2, in countryside / in city, interior materials)
- When you think of your dream home, what role does wood play in it?

(f) What does good indoor air mean, i.e. how do you define good indoor air quality? (Hint: How do you detect poor indoor air?)
- How could the use of wood as a material affect indoor air? Can you think of any positive or negative aspects?

(g) What positive and negative images or feelings does the wood evoke as an interior material? (e.g. floors, walls, ceilings, doors, countertops)
(h) What concerns you about the use of wood as an interior material from the human health (health safety) perspective? Are there any doubts?
- Do wooden interior materials seem to be more unreliable or more positive in terms of indoor air quality?

(i) Are there any concerns relating to use of wood from a sustainability perspective? (Hint: e.g. has there been something worrying when reading or watching the news?)

2. Health and well-being impacts of wooden interior materials

(a) What are your thoughts on the health impacts of wood as an interior material? What kind of health impacts do you recognize or know from the perspective of humans' physical and psychological health and well-being? (Hint: If you compare wooden floors and plastic carpets or what kind of feelings does an apartment evoke if there are a plenty of wooden materials?
(b) In what applications (in buildings) do you wish to use wooden interior materials from the human health perspective? In public buildings or homes? (Introduction: What kind of public buildings?)
(c) What kind of wooden interior materials are safe for health or promote health especially in homes (psychologically or physically)?
- What kind and how much wooden material would you like to have for your own home in terms of health?

3. Sustainability impacts of wooden materials

(a) What kind of sustainability impacts of wood use do you recognize or know? What are the impacts that are most relevant to sustainability? (Hint: How did you define sustainability in the context of housing and living earlier in the discussion and is it more sustainable to use wood or concrete?)
(b) In what applications (in buildings) do you wish to use wooden materials from the sustainability perspective? In public buildings or homes?
(c) (Hint: Do you think that wood use should generally be increased in construction? In what kind of public buildings?)
(d) What kind and how much wooden material would you like to have for your home in terms of sustainability? (Hint: Not at all, less than now, more than now)

4. Other

(a) What factors influence your choice of home (if you were buying an apartment)?
(b) What role does health and sustainability play or could play in choosing an apartment?

What kind of interior materials would you choose for your home and on what basis (if you were buying an apartment and could influence the materials)? (Hint: What aspects would you consider when choosing materials?) Would health aspects matter if you were buying an apartment and if you could influence it?

(a) Why aren't wooden interior materials used more than they are used now? (Hint: Why not in public buildings/homes? What could be the reasons behind this?)
(b) Where can you find information on the health and sustainability impacts of wooden materials and where would you look for it if needed? What do you consider to be a reliable source of information?
(c) If you were buying an apartment, would you rather buy an apartment with wooden interior materials or not if the apartments were otherwise completely identical, and why?

Recording ends

Final words:

- The opportunity for participants to comment or ask questions that were not addressed
- Possibility to provide feedback via email
- If participants wish, they will receive a summary of the findings or a research article after the study is completed.